# Science standards Grade 12

## Foundation level

## Scientific enquiry

By the end of Grade 12, students identify, develop and make predictions related to a clearly focused research question. They control variables, work as a team and use appropriate equipment and materials. They evaluate experimental design, identify weaknesses and develop realistic strategies for improvement. They work in an ethical manner. They understand the historical development of major scientific ideas and know scientific work is affected by its context. They are aware of the power and limitations of science in addressing questions. They record and process raw data appropriately and draw valid conclusions, allowing for errors and uncertainties. They handle equipment competently with due regard for safety. They follow instructions accurately but are able to adapt to unforeseen circumstances.

### Students should:

#### 1 Use methods of scientific investigation

1.1 Identify and develop a clearly focused research question.

Investigate factors limiting the rate of photosynthesis.

Determine how wind speed influences the rate of transpiration of a leafy plant.

Determine the acceleration due to gravity using a pendulum (advanced) or a free-fall method.

Determine the percentage of a commercial baking powder that is sodium bicarbonate.

1.2 Make predictions directly related to a research question.

Predict the progeny of a genetic cross.

Use modelling to predict changes in population density in predator–prey relationships.

Predict the characteristic properties of an element (e.g. tin, nickel) from its position in the periodic table and suggest ways to test some of the predictions.

Test the prediction that anodising a sample of aluminium increases its resistance to corrosion.

1.3 Identify and control variables.

Investigate the rate of osmosis between solutions of different concentration.

Investigate the rate of photosynthesis of an algal culture at different light intensities.

Compare the behaviour of different materials under stress.

1.4 Work constructively and adaptively with others as a team on a scientific investigation.

Work as a team to investigate the inheritance of selected characteristics of fruit flies.

Work as a team to investigate and explain the incidence of colour blindness in a community.

1.5 Evaluate experimental design, identify weaknesses and develop realistic strategies for improvement.

Develop and evaluate an experimental design to track the impact of humans on an area of desert.

Design an experiment to measure the rate of translocation in a green plant.

Identify the main sources of error when determining g by a free-fall method.

Identify the sources of error in an experiment to measure the power output of a muscle system and develop strategies for dealing with them.

1.6 Work in an ethical manner with regard to acknowledging data sources and authenticity of results.

Use published literature to find out the amount of selected yeast-based products produced annually in Qatar and in some other countries.

Write an illustrated report on the structure and function of chloroplasts.

Make a picture display of areas of Qatar that have been affected by industrialisation to illustrate positive and negative impacts.

1.7 Work in an ethical manner with regard to living things and the environment.

Carry out a survey of the habitats on a rocky shore to determine human impact.

Study the inheritance of characteristics of mice.

1.8 Identify, and make critical use of, secondary information.

Request information on the amount of sewage processed by sewage works in different areas of Qatar and account for the data.

Search the Internet for examples of genetically modified plants and their usefulness.

Download information on the explosion at Chernobyl from various sources to cross-check their veracity.

#### 2 Know how scientists work

2.1 Understand the historical development of major scientific ideas.

Make a video on the work of Mendel.

Research the development of theories of translocation.

Study the evolution of our ideas about the nature of light.

2.2 Know how scientific work is affected by its economic, social, cultural, moral and spiritual contexts.

Debate the cultural, ethical and moral constraints placed by societies on contentious scientific research (e.g. genetic manipulation and gene cloning).

Identify major scientific developments that have arisen from national needs (e.g. Germany’s need for a local source of fertiliser in 1914, the ‘space race’ of the late twentieth century).

2.3 Show an understanding of the power and limitations of science in addressing industrial, social and environmental questions.

Make a list of ways in which science can help stem the HIV/AIDS pandemic and a second list of problems associated with HIV/AIDS that science cannot resolve.

Discuss the reasons why, although we understand the biochemistry of human reproduction, some areas of the world are overpopulated and have an increasing birth rate.

See Standard 18.5

Debate issues around the deliberate and accidental release of harmful chemicals into the environment.

#### 3 Process and communicate information

3.1 Record raw data appropriately in a manner that allows easy interpretation.

Draw diagrams to illustrate the inheritance of alleles through generations.

Construct tables to describe the key characteristics of animals in different phyla.

Make large labelled diagrams of xylem and phloem cells.

3.2 Process raw data by the most appropriate means.

Graph data on the rate of photosynthesis in relation to temperature at different light intensities.

Collect data on people living with HIV/AIDS in different countries and present as percentages of population and as numbers per unit area of the country.

3.3 Draw valid conclusions, allowing for errors and uncertainties.

Rework the data on Mendel's experiments with peas and discuss the certainty of the conclusions.

Use a graphical method for determining g using a pendulum that allows errors to be spotted and eliminated.

3.4 Use an appropriate range of methods to communicate scientific information.

Use models to show mechanisms such as the structure of phloem and xylem.

Create a PowerPoint presentation about homeostasis.

Use applets to illustrate a variety of three-dimensional physical processes.

#### 4 Handle equipment and make measurements

4.1 Select and use correctly and competently the appropriate equipment and materials for an investigation, with due regard for the safety of self and others.

Use an oxygen meter in the study of photosynthesis.

Use a potometer to investigate transpiration.

Use a razor blade to cut sections and make slides of plant stems and leaves.

Use a xenon stroboscope to determine the frequency of a vibration.

Use a laser and a microwave generator to show interference.

Use a spectroscope to study emission and absorption spectra.

4.2 Follow instructions accurately but be able to adapt to unforeseen circumstances.

For Grade 12, foundation level, the weightings of the assessment objectives to be applied to each content strand are as follows:

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| --- | --- | --- | --- |
|  | Knowledge and understanding | Application, analysis and evaluation | Scientific enquiry skills and procedures |
| Assessment weighting | 45 to 55% | 25 to 35% | 20 to 25% |